Oryx Article

Revealing research preferences in conservation science

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Abstract Conservation researchers are increasingly drawing on a wider range of philosophies, methods, and values to examine conservation problems. In this article, we adopt methods from social psychology to develop a questionnaire with the dual purpose of illuminating diversity within conservation research communities and providing a tool for use in cross-disciplinary dialogue workshops. The questionnaire probes the preferences that different researchers have with regards to conservation science. It elicits insight into their motivations for carrying out research, the scales at which they tackle problems, the subjects that they focus on, their beliefs about the connections between nature and society, their sense of reality as absolute or socially constituted, and their propensity for collaboration. Testing the questionnaire with a group of 204 conservation scientists at a student conservation conference, we illustrate the latent and multidimensional diversity in the research preferences held by conservation scientists. We suggest that creating opportunities to further explore these differences and similarities using facilitated dialogue could enrich the mutual understanding of the diverse research community for responding to conservation problems.

Keywords Conservation social science; social psychology; interdisciplinary research; preferences; questionnaire; reflexivity; research design

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Introduction

Effectively responding to the unabated loss of species and ecosystems requires conservation researchers to work across disciplinary boundaries, think at multiple scales, and engage with diverse stakeholders. A growing awareness of the social and political dimensions of biodiversity loss has shifted conservation science from a discipline dominated by the natural sciences into a multi-, inter- and trans-disciplinary endeavour (Mascia et al., 2003; Sandbrook et al., 2013; Bennett et al., 2017). Conservation scientists are adopting a much more diverse range of approaches and increasingly carrying out cross-disciplinary collaborations to respond to conservation problems (Colloff et al., 2017). However, working across disciplines in conservation has known conceptual challenges, including competing theories of knowledge, disciplinary prejudices, and difficulties in interdisciplinary conversation (Fox et al., 2006; Adams, 2007; Eigenbrode et al., 2007; Sievanen et al., 2012; Pooley et al., 2014; Bennett et al., 2016). Overcoming these is thought to require an investment in initiatives that improve mutual-understanding of disciplinary diversity within the field (Campbell, 2005). As conservation science becomes increasingly pluralist in its methodologies, there is therefore scope for experimenting with new ways to examine diversity, and thereby help find common meaning across interdisciplinary teams.

The field of social psychology may offer some insight. Scholarship in psychology has been increasingly recognised for its potential to contribute to conservation research and practice (Saunders et al., 2006; Selinske et al., 2018). Work in this field to date has focused on the attitudes, and to a lesser extent behaviours, of societies and stakeholders with respect to conservation (St John et al., 2010). However, there is scope for the tools of social psychology to also be brought to better understand the attitudes and behaviours of research communities themselves. Scholars from the philosophy of science have previously developed and tested approaches to overcome disciplinary divides in the environmental sciences. The ‘Toolbox Project’, for example, has developed an approach to probing personal attitudes towards research and generating philosophical dialogue within research teams through responding to and discussing a set of open-ended questions (Eigenbrode et al., 2007). The approach has been widely tested in “Toolbox workshops”, in which research collaborators are encouraged to share and discuss their conceptual worldviews with collaborators (O’Rourke & Crowley, 2013). However, the Toolbox approach is a team-based method that requires a diversity of participants to be in the room and to sufficiently engage with the activity in order to support its success. Furthermore, the approach is predicated on qualitative and interpretive methods, which may not align with the expectations of some participants more accustomed to quantitative approaches.

In this paper, we set out to examine the potential of developing a conservation-specific tool that could quantitatively analyse diversity within the conservation research community and also be used to help multi-disciplinary teams of conservation researchers better understand each other. Drawing on methods from social psychology and building on insight from the Toolbox approach, we develop a questionnaire that reveals research preferences in conservation science. Research preferences are understood as the personal attitudes held by researchers with regards to the conduct of their research. In the field of psychology, such attitudes are understood to define the way that people form subjective understandings of the world around them and how that understanding is reflected in behaviour (Eiser, 1986). The use of questionnaires to probe the relationship between attitudes and behaviour has been widely applied in business management settings, through approaches such as personality-type questionnaires that examine how preferences manifest in different workplaces (Blackford, 2010; Bridges, 2010). Bringing these approaches to the field of conservation science, we develop a short questionnaire that probes the preferences that different researchers have with regards to conservation science. It elicits insight into their motivations for carrying out research, the scales at which they tackle problems, the subjects that they focus on, their beliefs about the connections between nature and society, their sense of reality as absolute or socially constituted, and their propensity for collaboration. The questionnaire can be used by single researchers for personal self-reflection or to analyse diversity within large groups, and can be combined with facilitated dialogue to support mutual understanding within cross-disciplinary teams.

Methods

This research was carried out in two interlinked stages between January and April 2017. The first stage sought to develop and validate a questionnaire (psychometric scale) to discern a set of research preferences (factors) within a conservation community. To do so, we used written questions to identify a respondent's preferences for different approaches to conservation research. The second stage used the results to examine the relationship between these new factors and the self-identification of respondents in relation to the categories of natural and social scientist. We carried out a statistical analysis of questionnaire results and demographic data within the sample population composed mostly of participants at a student conference on conservation science (Cambridge Student Conference on Conservation Science; SCCS).

An initial set of broad behaviours or attitudes to conservation research were identified by the research team from literature and exploratory interviewing with researchers in conservation science selectively sampled from zoology, geography, plant sciences, and history and philosophy of science.

This process yielded a list of six possible factors of interest that reflected behaviours or attitudes towards conservation research.

First, as in all fields (Eigenbrode et al., 2007), conservation researchers will be guided by particular motivations that relate to the aims that drive their work. Conservation science is often described as a 'mission-driven' discipline (Meine et al., 2006: 637; Mace, 2014), in which research is generally directed towards actions that “establish, improve or maintain good relations with nature” (Sandbrook, 2015: 565). However, there are likely to be differences in the extent that conservation researchers are motivated by achieving conservation outcomes or other kinds of impact, be they personally interpreted as changing the way issues are theorized to intervening in a specific conservation practice. Such motivations sit alongside other reasons for doing research such as curiosity or professional development, which will also be considered important.

Second, conservation research often involves methods that conform to particular scales of analysis, from the global to the local (Margulies et al., 2016). Research may focus on synthesis research or seek to identify generalizable trends, or it may closely examine case studies to identify localised specifics (Cox, 2015). These tendencies between the general and the specific are likely to reflect distinct beliefs about the universalism of science and the localised contingency of research (Douthwaite et al., 2003; Sutherland et al., 2017).

Third, as the field of conservation science has developed over recent decades, there have been notable shifts in the framing of conservation science with regards to the relative focus that is directed towards people and nature (Mace, 2014). Depending on their own personal and institutional backgrounds, conservation researchers are therefore likely to have distinct preferences for whether or not they dedicate their attention to species and ecosystems, or humans and their institutions in their work.

Fourth, alongside the focus of research, there are variations in the way different researchers view the relationship between the traditional categories of nature and society. Increasingly, the concept of socioecological systems is a prominent framework for thinking about the interconnectedness between social and ecological systems in environmental management (Berkes & Folke, 1998; Díaz et al., 2015). In parallel, social theory has sought to break down the dualism of nature and society by emphasising the hybrid networks of humans and non-humans that underpin both domains (Latour, 1993; Whatmore, 2002). Hence, there is likely to be variation amongst researchers about the extent to which nature and society are seen as hybridised or clearly distinct domains.

Fifth, extensive research in the philosophy of science has examined the alternative worldviews that lead some researchers to believe in the existence of an external reality that is knowable through scientific research, and others who accept the existence of many local socially constituted realities existing in the minds of different people (Proctor, 1998). These realist and relativist perspectives, respectively, are recognised as important operating distinctions in the environmental sciences, including conservation (Moon & Blackman, 2014).

Sixth, there are current debates about whether or not engaging stakeholders during research, rather than at the end of research, is useful for conservation outcomes (Nel et al., 2016; Sutherland et al., 2017). As such, there is likely to be variation in the degree to which conservation researchers seek to engage in pragmatic collaboration with stakeholders or work independently in framing the research question and processes.

In psychological terms, the identified behaviours or attitudes to research were considered to be 'factors' that could be understood through individual measurements (response to questions) and statistically analysed. For each factor, eight to ten corresponding questions were drafted for inclusion in the questionnaire. These were counterbalanced so that half represented endorsement of one extreme of the factor while the other half represented endorsement of its opposite. For example, questions pertaining to the subject-focus of research included questions indicating a focus on species and ecosystems (e.g. "In my research, I am primarily interested in the dynamics of animals, plants and their ecosystems") counterbalanced with those indicating a focus on humans and their institutions (e.g. "The primary goal of my research is to understand humans and their institutions better"). This ensured a balance of positive and negatively termed questions and resulted in the development of a 'long list' of 50 questions.

The 'long list' questionnaire was piloted with a small focus group to test for 'face validity' in order to carry out an initial revision of the questions. Participants involved in the focus group (n = 7) were selectively sampled from the University of Cambridge Conservation Research Institute to include a range of genders (men = 4, women = 3), disciplines (zoology = 4, geography = 2, plant sciences = 1) and world regions (Europe = 4, South America = 2, Africa = 1). The focus group lasted for an hour, in which participants were asked to complete the questionnaire and then report back any misunderstandings or reactions. Minor revisions to the balance and wording of questions were made following the focus group.

In March 2017, the revised questionnaire was posted online on the Qualtrics platform. Questions were placed in randomised order and demographic questions on age, gender, discipline, world region, and self-identification as a natural and/or social scientist were also added. We did not adopt

a fixed definition of these categories, but instead allowed respondents to self-identify. Participants were invited to complete the questionnaire between March and April 2017 by emails sent to the mailing lists of the 2016 and 2017 Student Conference on Conservation Science (SCCS) conferences and within University of Cambridge Conservation Research Institute, as well as posters and fliers distributed at the 2017 SCCS conference. The opportunity to enter an incentive prize draw for one gift card was made available to all participants. The online questionnaire received 204 complete responses, which provided the data through which the questionnaire was statistically validated through factor analysis.

Factor analysis

Before conducting the exploratory factor analysis, 6 items were removed because they correlated with one or fewer items, and one item that correlated at 0.2 level with 2 items. Then exploratory factor analyses were performed with Principle Axis Factoring extraction method with oblique (direct oblimin) rotation. The scree plot showed an inflection at approximately 6 to 8 factors, which corresponded with the a priori factor structure. Therefore, most of the analyses were set to extract 6-8 factors. Coefficients were suppressed below 0.3. With these parameters, a factor solution was chosen based on the criteria that all factors consisted of at least three variables that loaded above 0.3, while retaining as many of the original variables as possible. In order to arrive at this solution, items were removed if they consistently did not load onto any factors or if they cross-loaded evenly onto two or more factors. The final factor solution had Kaiser-Meyer-Olkin Measure of Sampling Adequacy=0.622, demonstrating that the sample is acceptable, although it would benefit from having a higher sample size (Kaiser, 1974). Bartlett's test of sphericity χ^2 (595.03) = 171, $p < 0.001$, indicated that correlations between items were sufficiently large for factor analysis (Field, 2009). Chronbach's alpha test for reliability has been included in the table of factor loadings.

Demographic analysis

Several analyses were run to evaluate the relationships between some of the independent variables and the mean scores on the new scale. As the data were non-normal, bootstrapping was used for the following parametric tests. In order to analyse the relationship between the categories of natural and social science, and the factors produced through the questionnaire, a one-way analysis of variance (ANOVA) with bootstrapping (with 1000 resamples) was carried out. This used data from three categories of scientific identity, namely: *natural scientist*, *social scientist*, or *both natural and social scientist.* Participants had been given the option to answer *neither*, but due to low number of people who chose this option (n=9), these were coded as missing for the analyses. In cases where

significant difference was identified, post-Hoc tests were run with Hochberg's GT2 due to the difference in sample sizes between the groups.

Results

Validated with a community of conservation researchers participating in a student conservation conference, the questionnaire received 204 responses that were sufficiently complete to be included in the analysis. This included 178 responses from the 349 conference participants invited (a response rate of 51%), and 26 from wider advertising via email.

Factor analysis

The factor analysis produced a statistically-grounded factor solution of six factors, each with three variables except for one that had four, for a total of 19 variables (Table SM1.1). This formed the basis of the final questionnaire comprised of 19 questions. Following validation, the factors were reviewed, assigned names and developed into complementary pairs by the research team. This resulted in a set of research preferences reflecting different philosophies, methods, and values. For questionnaire respondents, a high score in relation to a given factor indicated a tendency towards each research preference (left-hand column of Table 1.), with the right-hand column being developed as a complementary pair (right-hand column of Table 1.). These were denominated as: 'impact or outcome driven' and 'non-impact or outcome driven'; 'local specifics perspective' and 'general trends perspective; 'human-focused research' and 'nature-focused research'; 'nature and society separation' and 'nature-society hybridity'; 'relativist' and 'realist'; and, 'autonomous idealist' and 'pragmatic collaborator'. While in some cases the complementary pair was self-evident, for example the distinction between realism and relativism, in others the complementary pair could only be recognized for what it was not, such as the extent that research is impact or outcome driven. The characteristics of each factor were developed by giving them short descriptions that could help respondents understand their own results. These descriptions were derived from key words in the validated list of questions, but also necessarily required interpretation by the research team. Although the language of the questions can be interpreted in different ways by different respondents, the statistical analysis of the 204 respondents ensured that the questions and subsequent factors were clustered in a way that was consistently meaningful to these respondents and showed sufficient within-factor variation to be suitable markers of distinction between them. For the presentation of results, a spider diagram visualisation displaying the six factors visually for easy comparison was developed (illustrated in Figure 1.). A proposed workshop structure for a group activity and a printable version of the self-score questionnaire was also developed (SM2 and SM3 respectively).

Demographic analysis

Of the 204 total respondents of the questionnaire, there were 191 responses that included demographic data to carry out a comparative analysis between those that self-identified as a natural scientist, social scientist, or both (Table SM1.2.). Each of these groups showed wide variability in their responses for each of the six factors (Figure 1.). When comparison between these groups was analysed across the factors, ANOVA showed significant difference between the categories across some, but not all of the new factors (Figure 2.). While there was no significant relationship with tendencies for *impact driven (*$F(3, 196)=1.573$, $p>0.05$*), general trends perspective* ($F(3, 196)=0.498$, $p>0.05$*),* or *autonomous idealist* ($F(3, 196)=0.093$, $p>0.05$), there was a significant relationship with identifying as natural scientist, social scientist, or both, on *human-focused research* ($F(3, 196)=33.863$, $p<0.001$*), relativist* ($F(3, 196)=7.319$, $p<0.001$*),* and *nature and society separation* ($F(3, 196)=3.487$, $p<0.05$).

Post-Hoc tests (with Hochberg's GT2) showed that for *human-focused research*, social scientists (M=3.79, SD=0.78) scored significantly higher ($p<0.001$) than people who identified as both (M=3.03, SD=0.92) and than people who identified as natural scientists (M=2.12, SD=0.77). A higher score demonstrates greater interest in people and society than ecosystems, and those who identified as "both" also scored significantly higher ($p<0.001$) than natural scientists. For *relativist tendencies*, social scientists (M=3.67, SD=0.70) scored significantly higher ($p<0.05$) than natural scientists (M=3.22, SD=0.75), and while the "both" category (M=3.48, SD=0.69) did score higher than the natural scientists, this difference was not significant. For *nature and society separation*, natural scientists (M=1.99, SD=0.87) scored significantly higher ($p<0.05$) than people who identified as both (M=1.68, SD=0.62), and while "both" scored higher than social scientists (M=1.56, SD=0.53) occupying an intermediate position, this difference was not significant. It is worthwhile to note that for this factor the difference between natural scientists and social scientists was very close to being statistically significant, at $p=0.051$.

Discussion

The research set out in this article had the dual purpose of creating a questionnaire that could analyse diversity in the research preferences of conservation research communities and also be used to help multi-disciplinary teams of conservation researchers better appreciate each other's approaches to research.

The results from the student conservation conference illustrate the potential of this questionnaire to examine diversity within wider communities of conservation researchers. The questionnaire identified a diversity of research preferences both within the categories of natural and social

scientist, and between them. On average, the results show a statistical difference between the categories of social and natural sciences for the factors of human-focused research; nature and society separation; and the relativist worldview. However, notably, the results also show that respondents from these self-defined categories also exhibited high variability within these same factors. Self-identifying as a natural scientist did not preclude one from achieving a high score on the relativist factor, and vice versa. This perhaps reflects the known diversity of disciplinary approaches – from theoretical biology to bioinformatics, and from anthropology to economics – within the broad categories of the natural and social sciences in conservation (Bennett et al., 2017), and reinforces the limitations of applying this binary distinction when considering researcher diversity in conservation. Indeed, the existence of marked within group variability across the multidimensional factors of this questionnaire raise questions about the extent to which the categories of 'natural scientist' and 'social scientist' themselves offer meaningful distinctions in positioning researchers in the field of conservation research. Although these terms remain prominent in organisations such as the Society for Conservation Biology (Bennett et al., 2016), the results from this study suggest that more multidimensional measures of researcher diversity would be useful.

Further examination of what the self-assigned categories of 'natural scientist', 'social scientist' and 'both' of these mean to the questionnaire respondents may help elucidate how sense of researcher identity provided by these categories emerges through disciplinary training and how this influences philosophical positions. In our analysis, demographic data suggested that the vast majority of respondents entered the field from single disciplinary contexts. Significantly, biology, botany, computer science, ecology, mathematics and zoology fields were prominent entry routes for those identifying as 'natural scientists', but also those identifying as 'both' natural and social scientists. Further exploring how the research preferences that are nurtured through this early training of conservation researchers reinforces the emphasis of particular philosophies, methods, and values in examining conservation problems.

Drawing on the approach developed in this article, further research could apply this questionnaire to analyse both large and small research group composition in a range of settings. It could be used to understand research preference diversity within a collaborative research project, or it could be applied as a longitudinal measure, to see if individual tendencies change over time in response to education or experience in interdisciplinary collaborations.

In addition to being an analytical tool, the questionnaire and the personal profiles that can be produced from it could have application as tools for building researcher capacity in interdisciplinary

collaboration. In line with previous scholarship on the Toolbox approach (Eigenbrode et al., 2007; O'Rourke & Crowley, 2013), the questionnaire presented here could be used alongside carefully facilitated dialogue in order to support structured philosophical conversation. Workshops would allow respondents to both interrogate their own results and question the ways in which different preferences might shape their research collaborations. In this way, participants can learn from each other about why different approaches to research matter to conservation science.

The application of the questionnaire as a tool for reflection and facilitated dialogue, however, requires careful consideration about the ways in which different conservation researchers will relate to the questionnaire as *one* approach (among many) to responding to the previously highlighted conceptual challenges of multi-, inter-, and trans-disciplinary work in conservation. While the quantitative and categorical nature of the questionnaire is likely to appeal to those researchers who favour more positivist approaches, interpretive social scientists may feel that the questionnaire process and results are unable to reflect the complex philosophical position that they and those around them bring to research in practice (for further exploration of research philosophies in conservation, see Moon & Blackman, 2014). The application of the questionnaire as a tool for reflection and dialogue will therefore need to be done with care to take into account these diverse positions and many others.

The results of the questionnaire are intended to be indications of fluid tendencies within researcher preferences that can and will change over time. In this way, the questionnaire provides no normative position on where any individual or group positions sit. It is descriptive rather than prescriptive, and is not intended to create new dualisms between the extremes of different factors. For these reasons, the results are intended to be displayed as numerical positions in a spider diagram, along a spectrum, rather than assigned as a fixed category. While the contested nature of concepts and terms used in the questionnaire may lead some respondents to feel like the factors do not accurately reflect their worldviews we seek to emphasise that such reflections are perfectly valid. The sharing and discussion of these concerns through a group dialogue process is an intended outcome of this work. To further explore the challenges of applying the questionnaire methodology for this purpose, future research could empirically examine the way in which different researchers relate to the questionnaire as a tool for reflection and facilitated dialogue. As part of this, it would be valuable to understand the extent to which the questionnaire meaningfully reflects the general preferences of respondents, or if a different approach is needed to capture the preferences of increasingly pragmatic researchers that are accustomed to adapting their research methods and approaches to the changing nature of research problems.

Nevertheless, there is ample scope for further research into the potential contributions that social psychology might offer the conduct of conservation research itself. Further testing is required to examine whether facilitated dialogue about disciplinary differences can change a researcher's understanding of themselves and others in collaborative teams. Previous research suggests that critical examination of worldviews and philosophies can transform individual, organisational and group capacity as well as inform the ways in which other skills are deployed in pursuit of conservation science goals (O'Brien et al., 2013; Binder et al., 2015). Interventions that challenge researchers to externalise and justify their research preferences, such as the questionnaire presented here, are opportunities to build a greater appreciation for the range of different approaches to research that mutually coexist within the conservation field.

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Conflicts of interest None.

Ethical standards This research was conducted with ethical approval from the Department of Geography at the University of Cambridge (Research Ethics Assessment ID: 402, Approved: 9th February 2017).

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TABLE 1 Complementary pairs and their descriptions based on the validated questionnaire exploring research preferences in conservation science

Impact or outcome driven	*Non-impact or outcome driven*
This approach to research is driven by achieving impact or conservation outcomes and the belief that conservation research should always mobilise action.	This approach to research is not concerned with achieving conservation impact or outcomes, and may be motivated by many other factors such as curiosity or professional successes.
Local specifics perspective	*General trends perspective*
This perspective finds the details of specific research sites more interesting than general trends.	This perspective is more interested in broad scale processes and synthesis research than what happens in particular cases.
Human-focused research	*Nature-focused research*
This approach to research is primarily interested in the dynamics of humans and their institutions.	This approach to research is primarily interested in the dynamics of animals, plants and their ecosystems.
Nature and society as separate	*Nature-society as hybrid*
This worldview sees nature as clearly distinct from society and considers it appropriate to study natural and social systems as independent entities.	This worldview sees nature and society as hybrid entities made up of both human and non-human elements, which can never be truly separated.
Relativist	*Realist*
This worldview sees reality as something that is constructed in the minds of individual humans and is unique to each.	This worldview considers that there is only one reality, which can be directly studied and known through research.
Autonomous idealist	*Pragmatic collaborator*
This approach to research is likely to be independent from collaborators with opposing perspectives, as these are thought to compromise efficiency and integrity of research.	This approach to research is likely to be collaborative, and will involve work with stakeholders, even those that the researcher disagrees with.

FIG. 1 Spider diagrams of results for respondents identifying as a) natural scientist only, b) both natural and social scientist, and c) social scientist only. Grey lines represent individual respondents to show spread, and the black line represents the average of all responses.

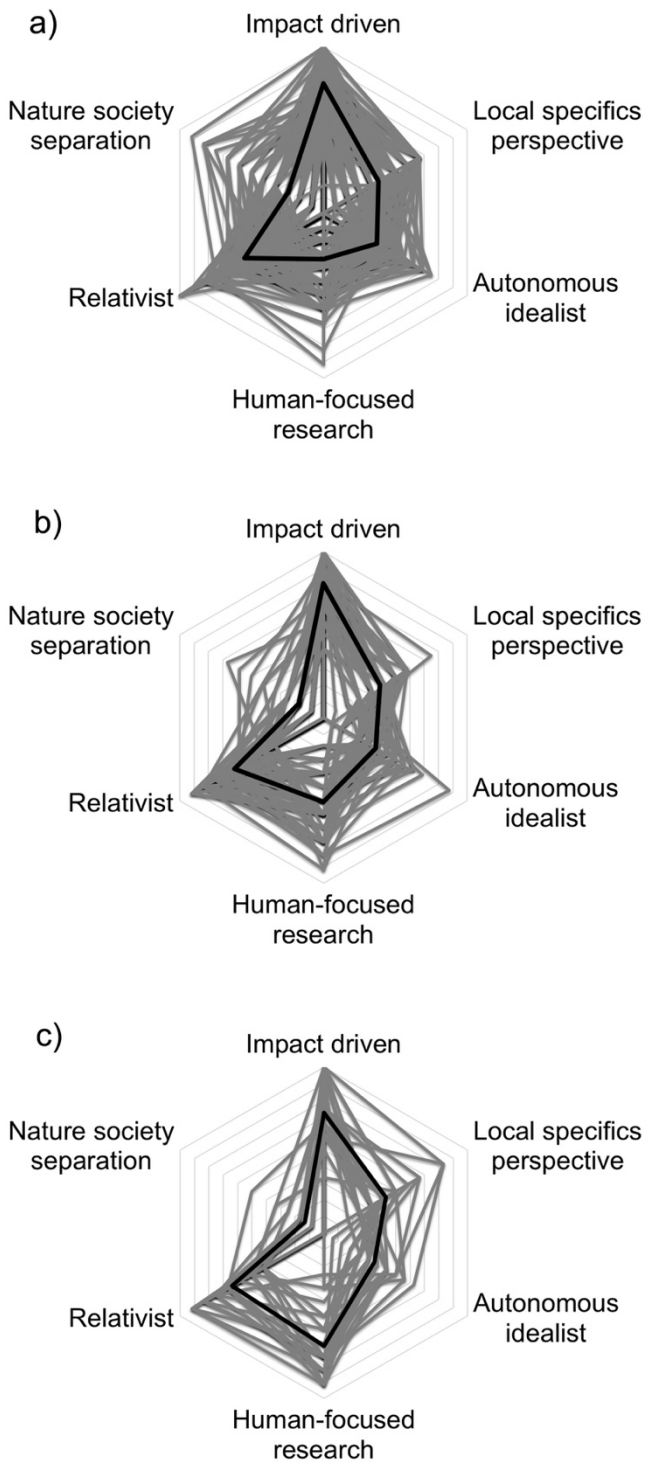

FIG. 2 Difference in mean score of questionnaire respondents that identified as natural scientist, both natural and social scientist, or social scientist across all six factors.